Beam Monitoring Time Stamps

http://minos.phy.bnl.gov/~bishai/minos/talks/ely2005/bmtiming.pdf.

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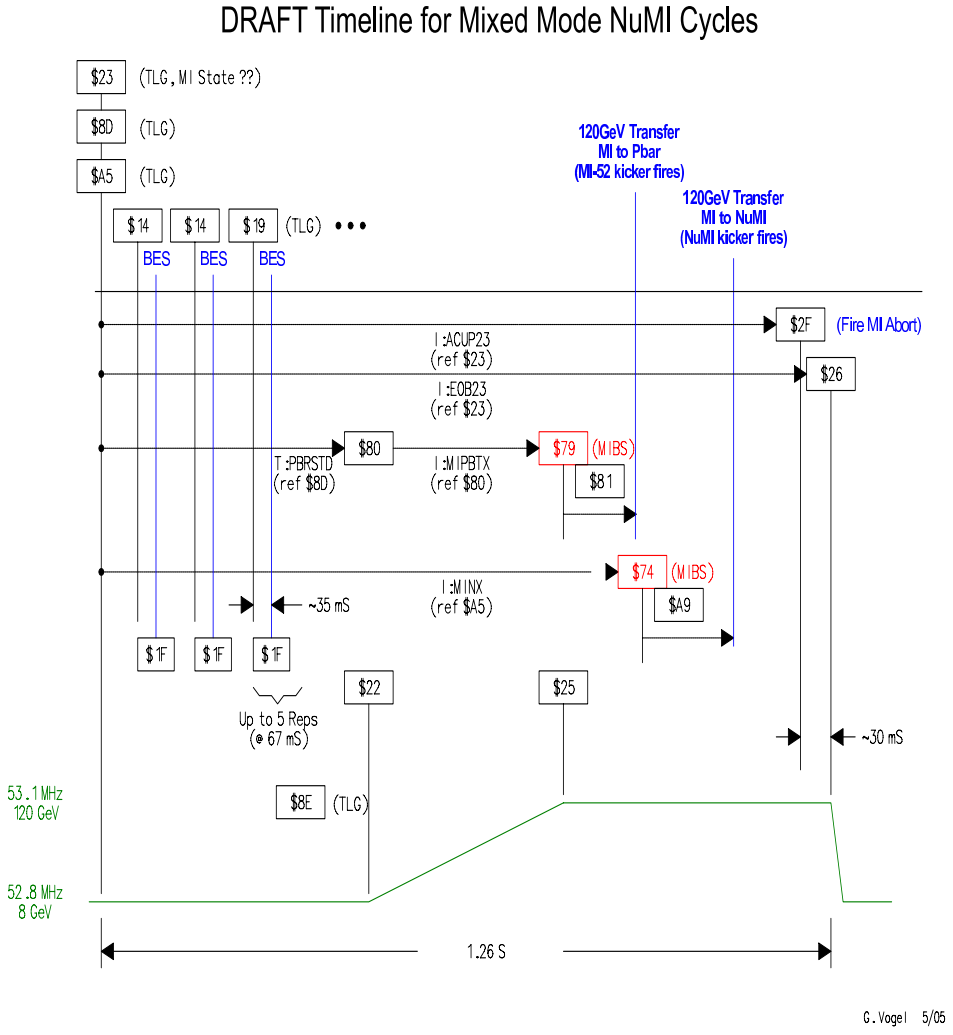
NuMI TCLK beam cycle timeline



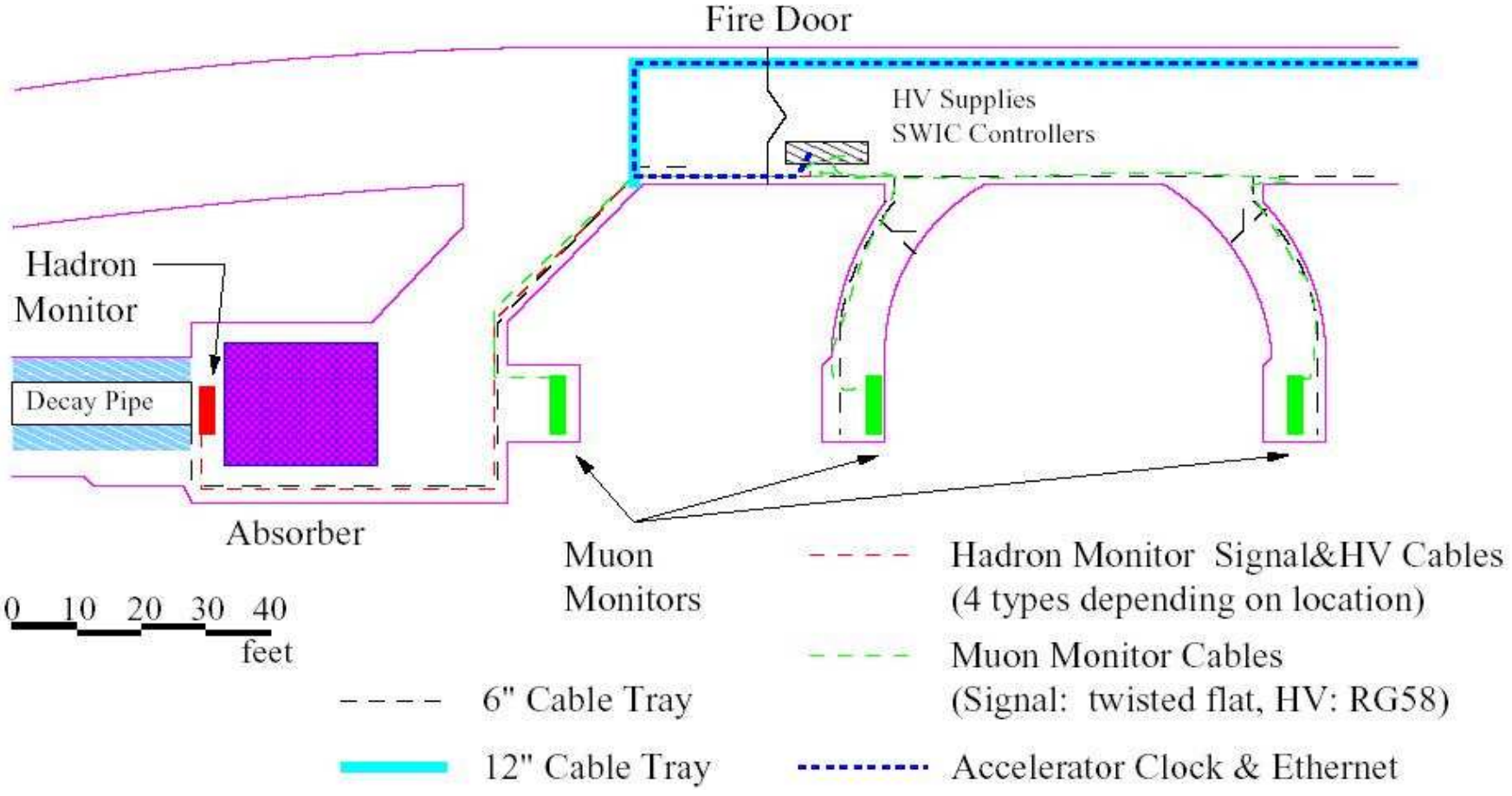
- **TCLK is a 256 bit frame sent throughout the accelerator system on a 10 MHz serial line.**
- **Each bit represents a beam cycle**
- **Cycle names are just hex representations of the TCLK bit**
- **← This is the latest NuMI beamline timing (subject to change)**

TCLK event definitions:

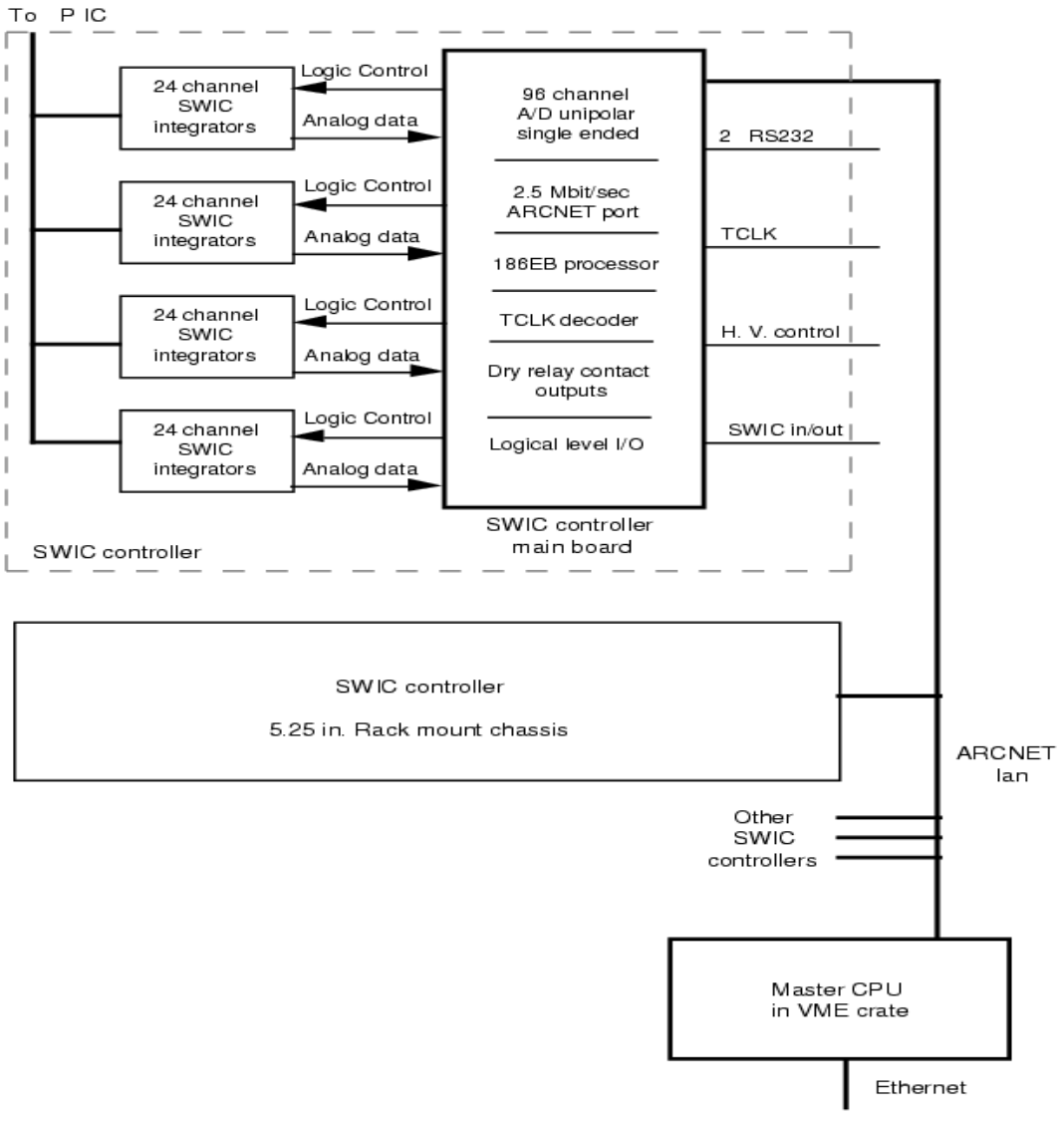
http://www-bd.fnal.gov/controls/hardware_vogel/tclk.htm

Had/Muon monitors

Hadron and muon monitors are Pad Ionization Chambers located $\sim$ 2500 feet from target. A SWIC controller system decodes TCLK, digitizes and reads out the PIC:



PIC → SWIC → → → → VME



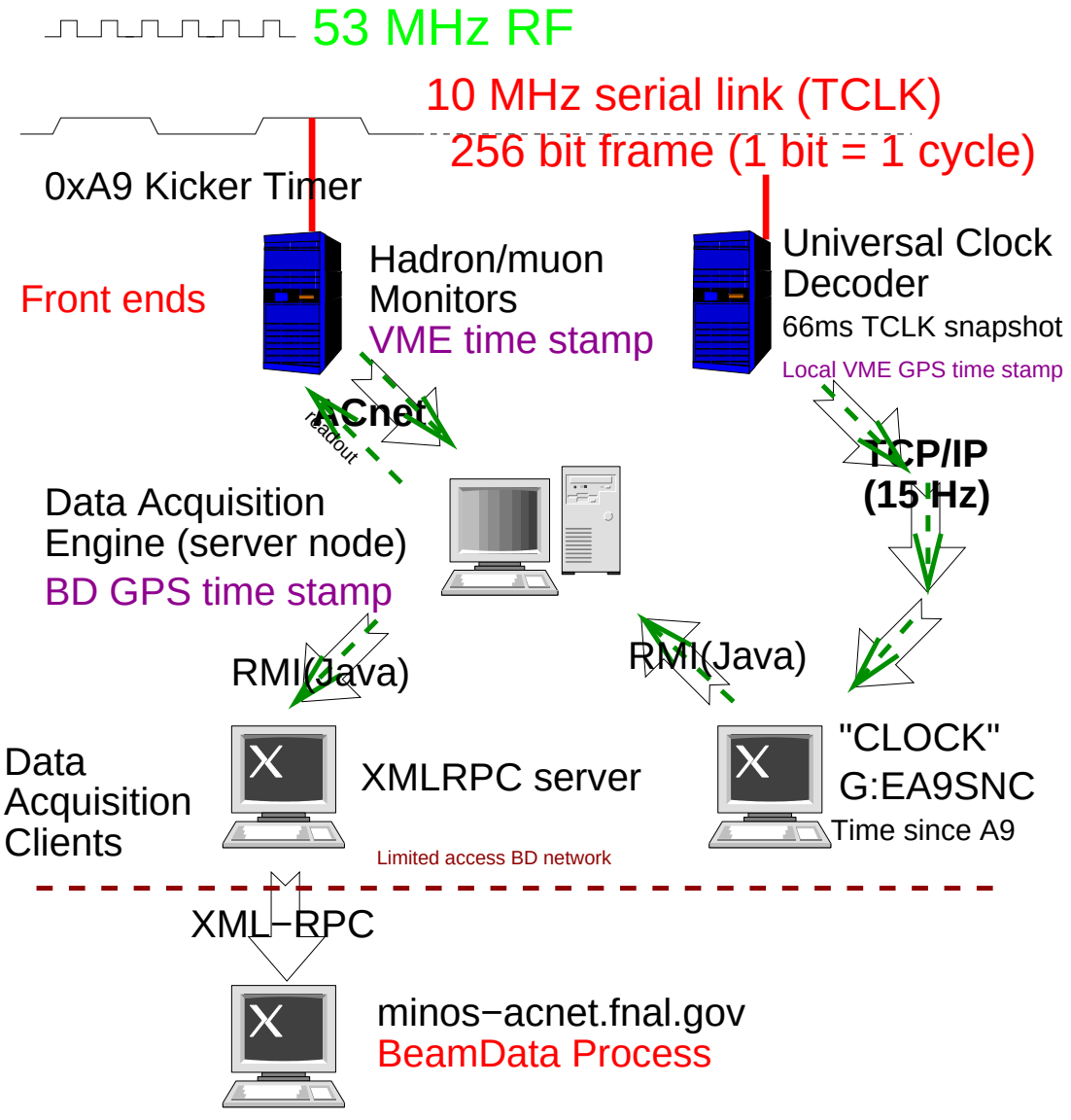
- **Integration gates open 1-5μs after $A9. Integration time is 1ms and 10ms for mu/had and profile respectively.**
- **The first time stamp is applied by the VME CPU after it obtains the SWIC data via a the ARCNET serial link (2.5 Mbit/sec.)**
- **This is also available for newer NuMI BPMs**

VME Timestamps

- VME controller runs VxWorks - a real time unix-like OS
- The VxWorks processor synchronizes with a unix system that is synchronized with a BD GPS. $\approx$ ms precision.
- Computers on the BD network get NTP time from two local GPS stratum 1 servers; bdtime-1.fnal.gov & bdtime-2.fnal.gov.
- IN ADDITION a GPS front-end generates an 8F TCLK event every second as measured by the GPS.
- When the VME front-end receives the 8F event, it further synchronizes its internal time, and keeps doing this. $\approx$ 10 μs precision.
- This infrastructure was mainly driven by miniBoone requirements, where they need 15 Hz precision.

Does MINOS GPS = BD GPS timescale?

DAE Time Stamps & Data Access



- **Data Acquisition Engines (DAE) speak ACNET to FEs and serve data to client software.**
- **All data are time stamped when recieved by the DAE .**
- **Front ends with a hardware TCLK link can collect data on a TCLK cycle independant of the DAE - like BPMs, toroids and SWICS.**
- **All other data access (including delays) is via soft access mode. DAE waits until it recieves the TCLK via an ethernet multicast (15 Hz) before requesting data from the FE.**

Accessing NuMI Data Offline

- Charlie King's XML-RPC server $\longrightarrow$ BeamData process $\longrightarrow$ minos-acnet.fnal.gov $\longrightarrow$ archive (Bretts talk).
- From archive, Brett converts raw data to a flat Root TTree.
- Used standalone Root macros to analyze TTree.
- Temporary beam summary ntuples are at

  http://minos.phy.bnl.gov/~bishai/minos/data/BD
- NEW framework ready for adding beam info to standard ntuple - see Brett's talk this afternoon.

BeamData Performance

Problem with BPM data logging was fixed on May 4th - previously BPM data was unreliable with 25% failure rate due to early reset of the BPMs.

Group 1 SWICs VME sequencer switched off on May 15/16 - lost 10545/35568 spills. (MTGT not in this group). Add sequencer monitoring.

Failure of minos-acnet.fnal.gov caused loss of data for $\sim$ 1/2 day from May 1-31st. New dedicated system ordered to isolate data logging from monitoring. Backup process to run on minos0X.

Recent device readout failure rates:

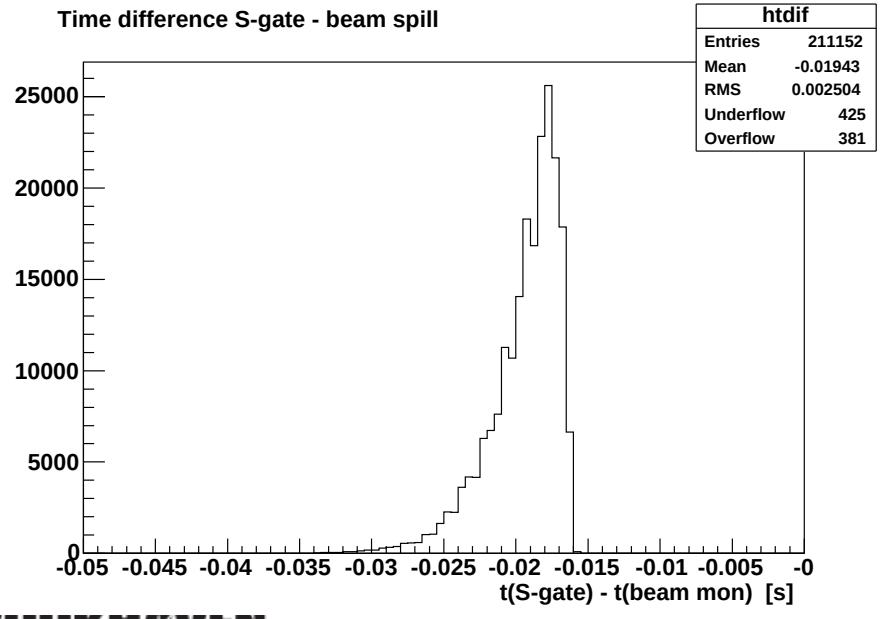
Dates	**May 17-31,2005**
Total spills	**360268**
TORTGT	**8 (2×10^{-5})**

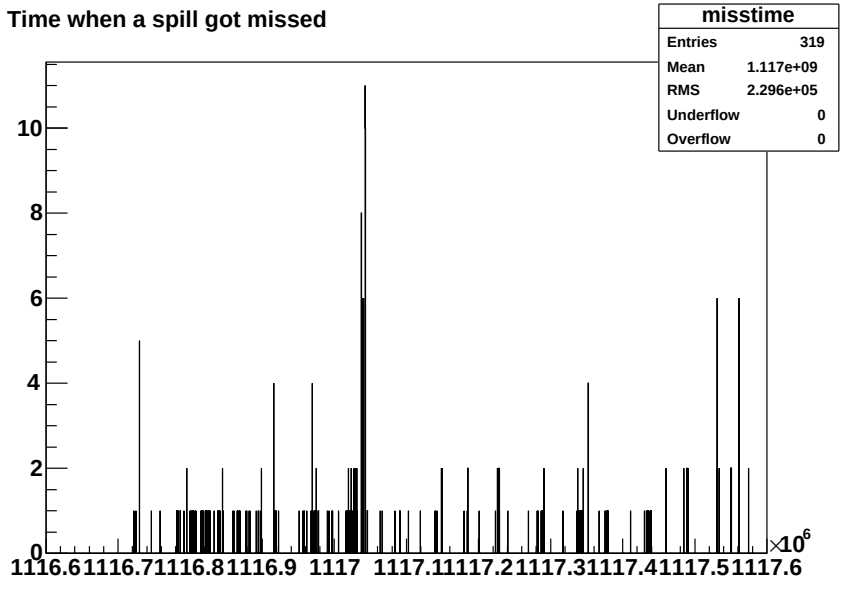
HPTGT	**39 (1×10^{-4})**
MTGT	**21 (6×10^{-5})**
HAD/MU	**13 (4×10^{-5})**

Beam-ND data matching

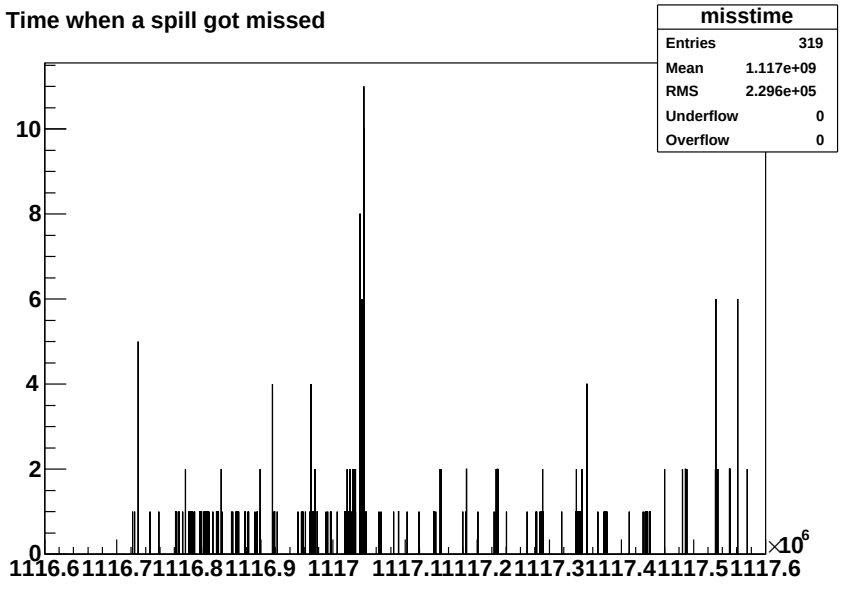
The best timestamp is the GPS timestamp obtained from the profile and mu/had monitor front-end VME which are triggered by the $A9. If no reliable VME timestamp is obtained use the DAE timestamp which is triggered by a 15Hz TCP/IP multicast of $A9 ($\mathcal{O}(100ms)$).

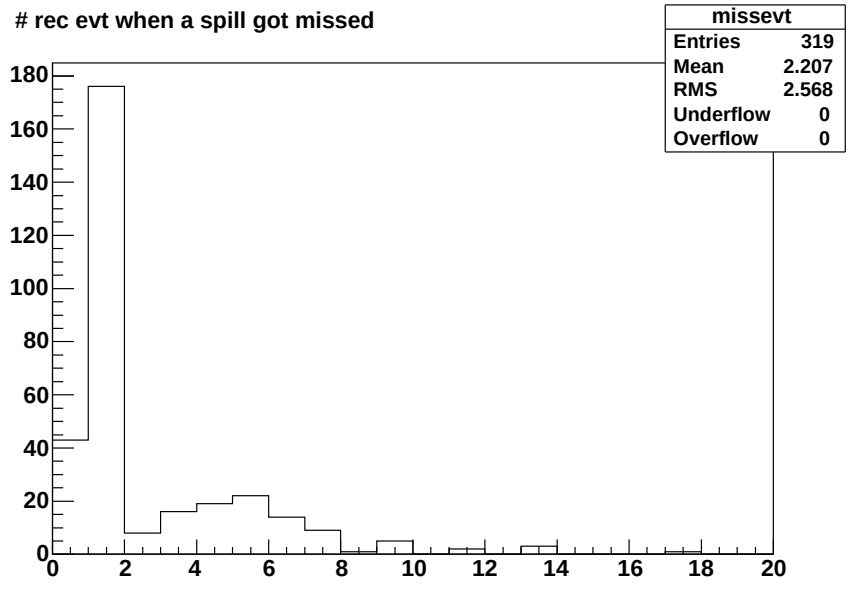
ACTION ITEM: During May pLE data running, failed to match 319 of 211471 spills (0.15%).





Unmatched are real data





Action items

- Commission new BeamData logging system and initiate backup process.
- Determine MINOS DAE/XML-RPC livetime (how ??).
- Identify the cause of missing BeamData-ND spills.
- Optimize VME response time for more accurate timestamps (?????).
- Commission the new BeamData framework to add spill information to database and ND ntuples (see Brett and Marks talks)